strictly nonblocking manner if each multicast connection is fanned out into at most three middle switches. FIG. 6A shows a general symmetrical multi-stage network with $m = 4 * n - 1$ middle switches. Excepting for the middle switches to be $m = 4 * n - 1$, the description of FIG. 6A is similar to FIG. 2A. FIG. 6B shows the scheduling method by fanning out into at most three middle switches. Excepting for the additional act 142D of testing for three middle switches and setting up a connection through three middle switches in act 142C, the description of the method of FIG. 6B is similar to the method of FIG. 3A.

In general when $m = (x+1) * n - 1$ and $x \geq 2$ each multicast connection can be fanned out into at most x middle switches and the $V(m,n,r)$ is operated in strictly nonblocking manner. Similarly, when $m = x * n_1 + n_2 - 1$, the $V(m,n_1,r_1,n_2,r_2)$ network is operated in strictly nonblocking manner if each multicast connection is fanned out into at most x middle switches. FIG. 7A shows a general symmetrical multi-stage network with $m = (x+1) * n - 1$ middle switches. Excepting for the middle switches to be $m = (x+1) * n - 1$, the description of FIG. 7A is similar to FIG. 2A. FIG. 7B shows the scheduling method by fanning out into at most x middle switches. Excepting for the additional act 142X of testing for x middle switches and setting up a connection through x middle switches in act 142C, the description of the method of FIG. 7B is similar to the method of FIG. 3A.

In an alternative embodiment, when $m \geq x_1 * a_1 + x_2 * a_2 + ... + x_p * a_p + n_1 - 1$, where $a_1 + a_2 + ... + a_p = n_1 + n_2$, the $V(m,n_1,r_1,n_2,r_2)$ network is operated in strictly nonblocking manner as described herein, when multicast connections are set up such that connections from a_i inlet links of each input switch pass through at most x_i middle switches for $1 \leq i \leq p$.

Numerous modifications and adaptations of the embodiments, implementations, and examples described herein will be apparent to the skilled artisan in view of the disclosure.

For example, in one embodiment a method of the type described above is modified as follows when the number of output switches r_2 is less than or equal to four. Specifically, a three-stage network is operated in strictly nonblocking manner when the multicast connection is fanned out only once in the input stage, with m number of middle stage switches where

$m \geq \lfloor \sqrt{r_2} \rfloor * MIN(n_1, n_2)$ when $\lfloor \sqrt{r_2} \rfloor$ is >1 and odd, or when $\lfloor \sqrt{r_2} \rfloor = 2$,

$m \geq (\lfloor \sqrt{r_2} \rfloor - 1) * MIN(n_1, n_2)$ when $\lfloor \sqrt{r_2} \rfloor$ is >2 and even, and

$m \geq n_1 + n_2 - 1$ when $\lfloor \sqrt{r_2} \rfloor = 1$. So when r_2 is less than equal to fiver a three-stage network is operated in strictly nonblocking manner for $m \leq 2 * n$.

For example, in another embodiment, a method of the type described above is modified to set up a multirate multi-stage network as follows. Specifically, a multirate connection can be specified as a type of multicast connection. In a multicast connection, an inlet link transmits to multiple outlet links, whereas in a multirate connection multiple inlet links transmit to a single outlet link when the rate of data transfer of all the paths in use meet the requirements of multirate connection request. In such a case a multirate connection can be set up (in a method that works backwards from the output stage to the input stage), with fan-in (instead of fan-out) of not more than two in the output stage and arbitrary fan-in in the input stages and middle stages. And a three-stage multirate network is operated in rearrangeably nonblocking manner with the exact same requirements on the number of middle stage switches as described above for certain embodiments.

Numerous such modifications and adaptations are encompassed by the attached claims.